

Grades 9–12: Data Analysis and Probability

Data resources from the Internet, statistical software, and graphing calculators with statistical features are essential to the instruction and assessment of data analysis and probability.

STANDARD	I.	Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
EXPECTATION	A.	Understand the differences among various kinds of studies and which types of inferences can legitimately be drawn from each. 1. Distinguish among surveys, observational studies, and controlled experiments and evaluate the quality of each. 2. Evaluate the legitimacy of conclusions about the population based on the sample(s) studied.
EXPECTATION	B.	Know the characteristics of well-designed studies, including the role of randomization in surveys and experiments. 1. Identify two or more experimental treatments (or conditions) to be compared and the sources of variation to be controlled. 2. Compare the responses of a group that gets treatment with those of a control group that does not. 3. Given a problem situation, describe the basic principles of experimental design (control, randomization, and replication). 4. Given a problem situation, evaluate whether conclusions drawn are based on randomization and control.
EXPECTATION	C.	Understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable. 1. Given a problem situation, identify variables as categorical or measurement. 2. Given a problem situation, distinguish between independent/explanatory and dependent/response variables.

EXPECTATION

D. Understand histograms, parallel box plots, and scatterplots and use them to display data.

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| 1. Represent, display, and interpret data using scatterplots, bar graphs, stem-and-leaf plots, and box-and-whiskers diagrams including representations on graphing calculators and computers. |
| 2. Display univariate data in problem situations with parallel box plots, histograms, or stem-and-leaf plots. |

EXPECTATION

E. Compute basic statistics and understand the distinction between a statistic and a parameter.

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| 1. Given a problem situation, identify each variable as a statistic or a parameter. |
| 2. Calculate measures of center and spread for univariate statistics. |
| 3. Determine positive, negative, or no correlation between bivariate statistics. |

STANDARD

II. Select and use appropriate statistical methods to analyze data.

EXPECTATION

A. For univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics.

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| 1. Given a problem situation, select the appropriate display and describe the distribution's overall shape and characteristics. |
| 2. Based on the shape of the distribution, determine how the measures of center and spread are related to each other. |

EXPECTATION

B. For bivariate measurement data, be able to display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools.

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| 1. Interpret the value of the correlation coefficient as it pertains to the relationship between the two variables. |
| *2. Write a linear equation that fits a data set, check the model for “goodness of fit,” and make predictions using the model. |

EXPECTATION

C. Display and discuss bivariate data where at least one variable is categorical.

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| 1. Given a problem situation with one variable as categorical and the other as measurement, compare the categorical variables using the appropriate display for the measurement variables and draw conclusions from those comparisons. |
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EXPECTATION

D. Recognize how linear transformations of univariate data affect shape, center, and spread.

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| 1. Describe the effect of transformations of data on measures of central tendency and variability. |
| 2. Describe the effect of transformations of data on the shape of the data's distribution. |

EXPECTATION

E. Identify trends in bivariate data and find functions that model the data or transform the data so that they can be modeled.

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| 1. Draw a line-of-best-fit or a curve-of-best-fit for a scatterplot. |
| 2. Determine the function that models the data best. |

STANDARD

III. Develop and evaluate inferences and predictions that are based on data.

EXPECTATION

A. Use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions.

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| 1. Conduct simulations to collect random sample statistics and examine the variability of them from a known population. |
| 2. Conduct simulations to construct sampling distributions. |

<p>EXPECTATION</p>	<p>B. Understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference.</p>
	<ol style="list-style-type: none"> 1. Use the properties of the normal curve to describe how sample data estimates the population mean and standard deviation. 2. Examine sampling distributions to make inferences and predictions about population parameters.
<p>EXPECTATION</p>	<p>C. Evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions.</p>
	<ol style="list-style-type: none"> 1. Given a published report based on data, determine the design of the study, the appropriateness of the data analysis, and the validity of the conclusions. 2. Given a published report based on data, interpret the results.
<p>EXPECTATION</p>	<p>D. Understand how basic statistical techniques are used to monitor process characteristics in the workplace.</p>
	<ol style="list-style-type: none"> 1. Apply confidence intervals and margins of error to workplace processes. 2. Interpret the results of hypothesis testing for a single proportion or mean.
<p>STANDARD</p>	<p>IV. Understand and apply basic concepts of probability.</p>
<p>EXPECTATION</p>	<p>A. Understand the concepts of sample space and probability distribution and construct sample spaces and distributions in simple cases.</p>
	<ol style="list-style-type: none"> 1. Describe all possible outcomes of an event containing a finite number of outcomes. 2. Determine a sample space for selected experiments and represent it in the form of a list, chart, picture, or tree diagram.

EXPECTATION

B. Use simulations to construct empirical probability distributions and interpret the results in the context of an applied problem.

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| 1. Use simulations to construct empirical probability distributions. |
| 2. Interpret the results in the context of an applied problem. |

EXPECTATION

C. Compute and interpret the expected value of random variables in simple cases.

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| 1. Given a problem situation, delineate the sample space and conduct simulations to calculate the expected value of the random variables. |
| 2. Given a problem situation, interpret the expected value of the random variables. |

EXPECTATION

D. Understand the concepts of conditional probability and independent events.

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| 1. Identify mutually exclusive, joint, and independent events. |
| 2. Recognize and compute conditional probability. |

EXPECTATION

E. Understand how to compute the probability of a compound event.

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| 1. Empirically and theoretically calculate the probabilities of a compound event. |
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